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NOTE

CONFIRMATION THAT *DIRCA* SPP. (THYMELAEACEAE) REPRODUCE FROM RHIZOMES

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There are three North American species of deciduous shrubs in the genus *Dirca* L. *Dirca palustris* L. occurs in the eastern United States and in southeastern Canada (Vogelmann 1953). Although its distribution is broad, *D. palustris* typically is obscure locally and is restricted to moist soils as an understory species along wooded slopes (Kurz 1997). *Dirca occidentalis* Gray also occurs on slopes (McMinn and Forderhase 1935), but its distribution is narrowly restricted to six counties of California near the San Francisco Bay. Within this area, *D. occidentalis* inhabits cool niches with frequent fog and relatively uniform soil moisture (Johnson 1994). *Dirca mexicana* Nesom & Mayfield was discovered in 1994 as one population of 800 to 1000 plants along a slope in the Sierra Madre Oriental of Tamaulipas, Mexico (Nesom and Mayfield 1995).

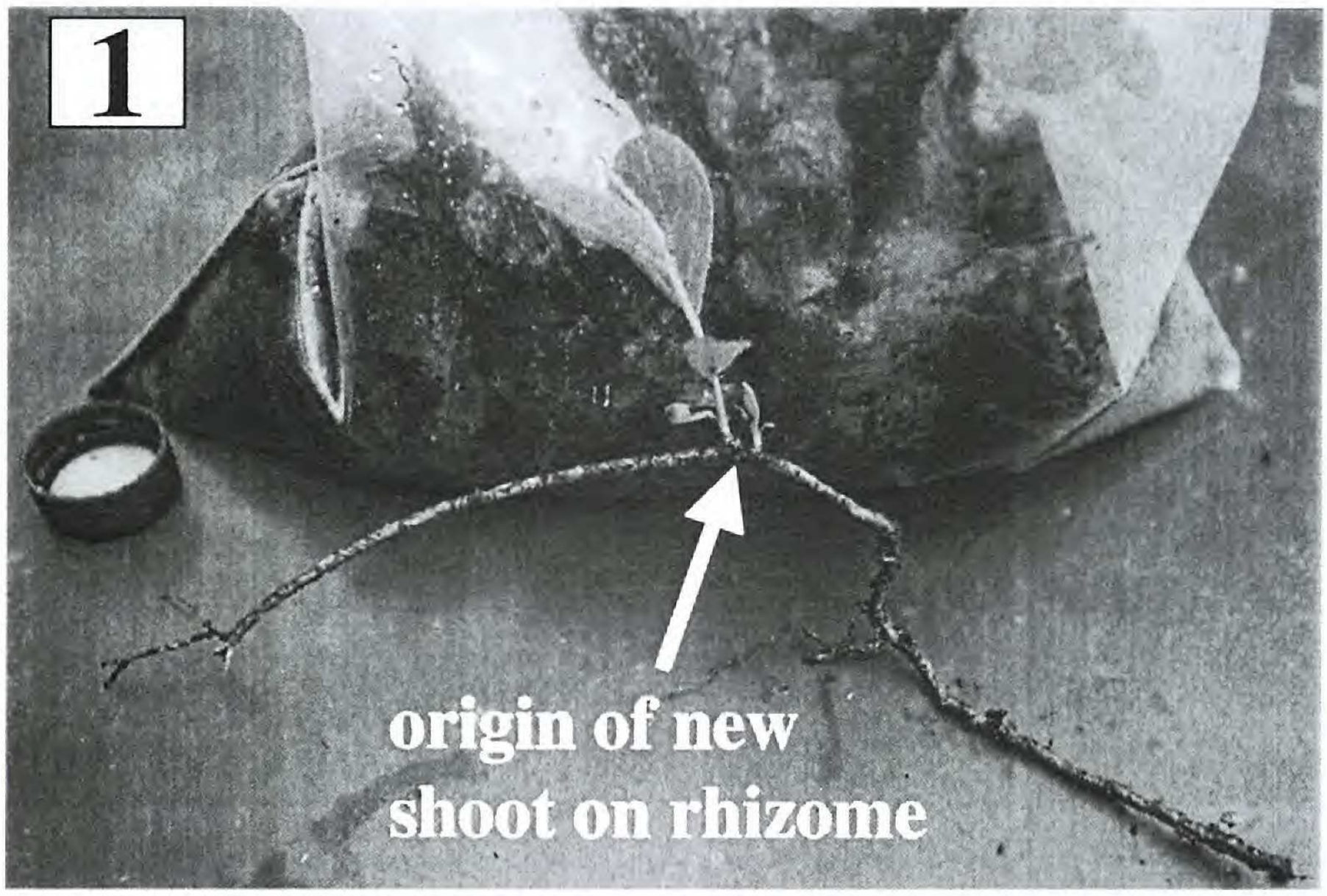
Local or global rarity of all *Dirca* spp. underscores the need to understand how these shrubs regenerate. Sexual reproduction involves the vernal development of single-seeded drupes (Vogelmann 1953). Germination rates up to 61% have been reported for *D. palustris* (Del Tredici 1983), and seedlings may develop beneath mature plants (Dirr and Heuser 1987). McMinn and Forderhase (1935) observed few fruits on *D. occidentalis*. Johnson (1994) concurred and attributed declines in populations of the species to poor fecundity, low rates of germination, seedling mortality, and competition. Nesom and Mayfield (1995) observed immature fruits on *D. mexicana* on 3 March 1995. Subsequent visits I have made to the site confirm that mature drupes with viable seeds abscise from *D. mexicana* during May.

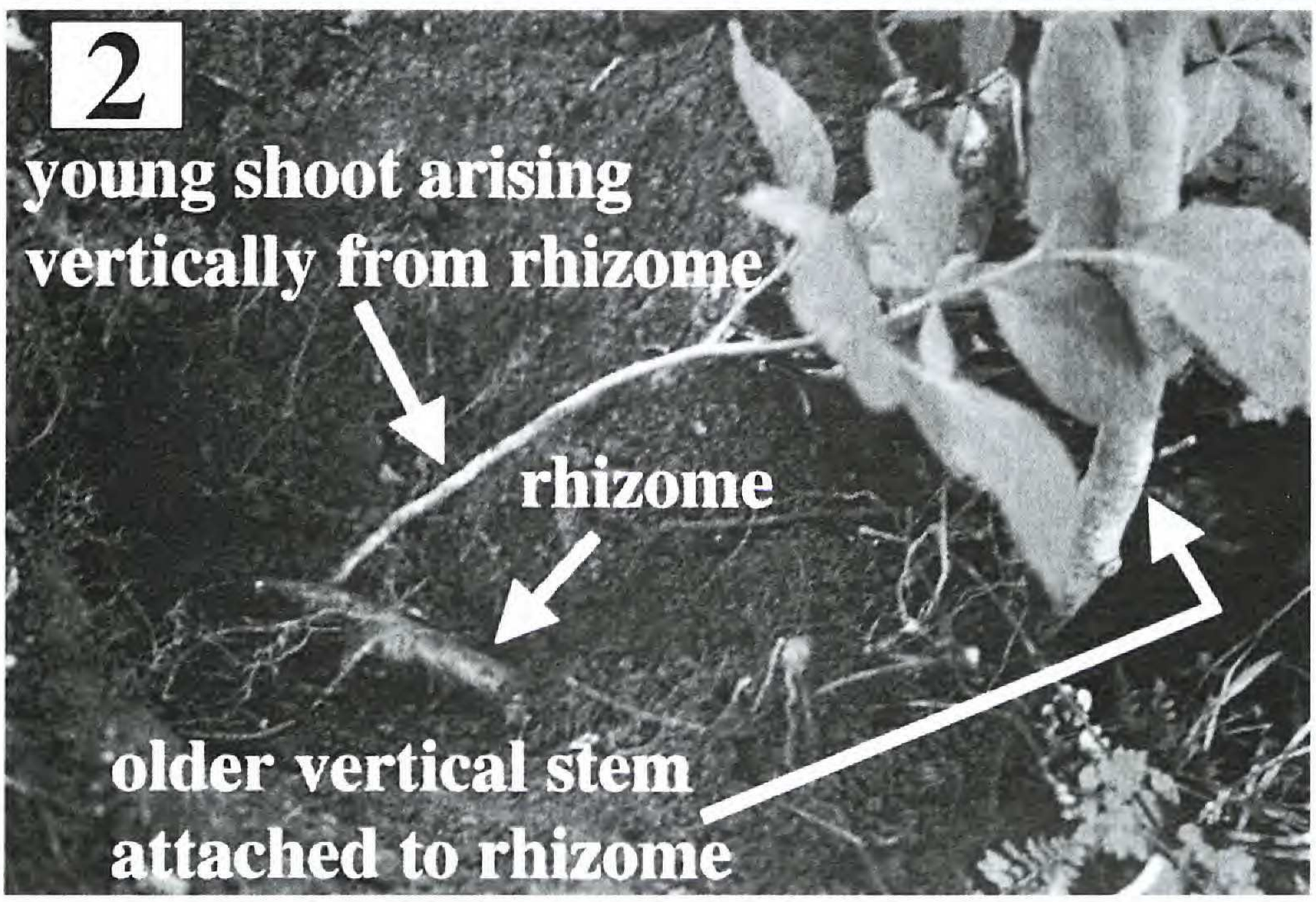
The certainty that all *Dirca* spp. regenerate sexually is contrasted by the doubt surrounding whether they spread asexually. Two modes of asexual regeneration, layering and rhizome development, are plausible based on previous descriptions of the three species in their native habitats. Stems of mature plants can become prostrate along the slopes that support populations of *Dirca* spp. Although such stems may remain

in contact with the ground for many years, adventitious root formation on prostrate stems of *Dirca* spp. has not been documented. Reports that all attempts to induce roots on stems of *D. palustris* have failed (Dirr and Heuser 1987), and that a controlled attempt to layer *D. palustris* was unsuccessful (Hendricks 1985), are additional indications that layering does not occur or is rare. McMinn and Forderhase (1935) stated that plants of *D. occidentalis* arise from "underground stems which run parallel to the surface of the ground" and that it is "difficult to find young plants . . . not connected to the parent plants." No evidence was provided for this definitive claim, nor has the possibility of rhizome development been addressed thoroughly during the ensuing 70 years. Although they did not examine the population of *D. mexicana* for rhizomes, Nesom and Mayfield (1995) stated that clonal reproduction was not evident and that the report of rhizomes by McMinn and Forderhase (1935) remained unsubstantiated. My objective for this note is to provide evidence for the regeneration of *Dirca* spp. from rhizomes.

I received permission from the Mexican and U.S. governments to import a small number of young plants of *Dirca mexicana* from the native habitat in Mexico to Iowa. Local assistants helped me to use information from Nesom and Mayfield (1995) to find the plants on 19 May 2002. Numerous newly germinated seedlings from fruits dispersed during previous years were observed. Upon excavating what appeared to be a seedling without cotyledons, I discovered it be a vertical shoot attached to a horizontal stem in the soil. A section of the rhizome was removed and photographed (Figure 1). The plant from which the rhizome had formed was not obvious, and I did not excavate further to determine the origin of the rhizome. I have observed similar regeneration of *D. palustris* at a site in Clayton County, Iowa. Figure 2 shows a young shoot that had formed from a rhizome I exposed by careful excavation on 7 June 2003. Gentle agitation of the thicker, vertical stem on the right side of the image caused the rhizome to move, indicating that both shoots in the image were attached to the rhizome.

These recent observations are evidence for clonal regeneration of *Dirca mexicana* and *D. palustris*. Considering the earlier description by McMinn and Forderhase (1935) of new plants of *D. occidentalis* from underground stems, it is likely that all *Dirca* spp. regenerate from rhizomes. The frequency of this mode of reproduction has important ramifications but is unknown. While rhizomatous spread represents a second strategy through which populations of these species can be sustained, genetic diversity likely would decrease with increases in the extent to which asexual reproduction predominates over the generation





Figures 1–2. Rhizomes of *Dirca* spp. 1. Detached segment of a rhizome of *D. mexicana*. This sample was obtained from the only known population of the species in Tamaulipas, Mexico. A new shoot that had emerged from the soil and a root attached to the rhizome to the right of the shoot are evident. 2. Rhizome at the bottom of a hole dug in the soil within a population of *D. palustris* in Clayton County, Iowa. The attachment of the younger shoot to the rhizome was observed. Agitation of the older, vertical stem on the right side of the image evoked movement of the rhizome, indicating attachment.

of new plants from seed. Those concerned with conserving *Dirca* spp. should consider that low genetic diversity may exist within populations previously presumed to have arisen exclusively through sexual means. This may be particularly relevant for the only known population of *D. mexicana* and for *D. occidentalis*, which is threatened and in decline (Johnson 1994).

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